
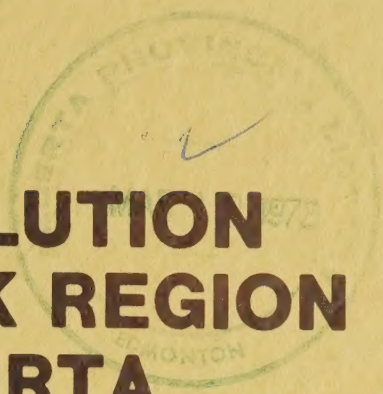


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ENVIRONMENTAL POLLUTION IN THE DRYWOOD CREEK REGION OF SOUTHERN ALBERTA

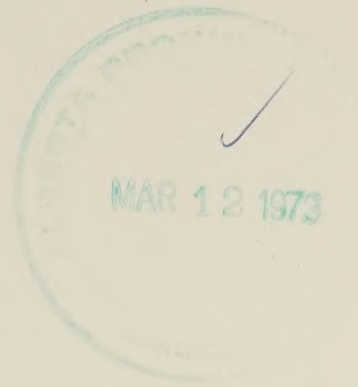
A Brief Submitted To The Alberta Department Of The Environment

[Briefs submitted to the Dept]

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ENVIRONMENTAL POLLUTION IN
THE DRYWOOD CREEK REGION OF
SOUTHERN ALBERTA

A Brief Submitted
to the Alberta Department of
the Environment

Amended Version
November 23, 1971,

Department of Geography
University of Alberta


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Cover: The Southern Alberta Foothills; the Drywood Creek region is near the left horizon. Photograph by William Yakubiec.

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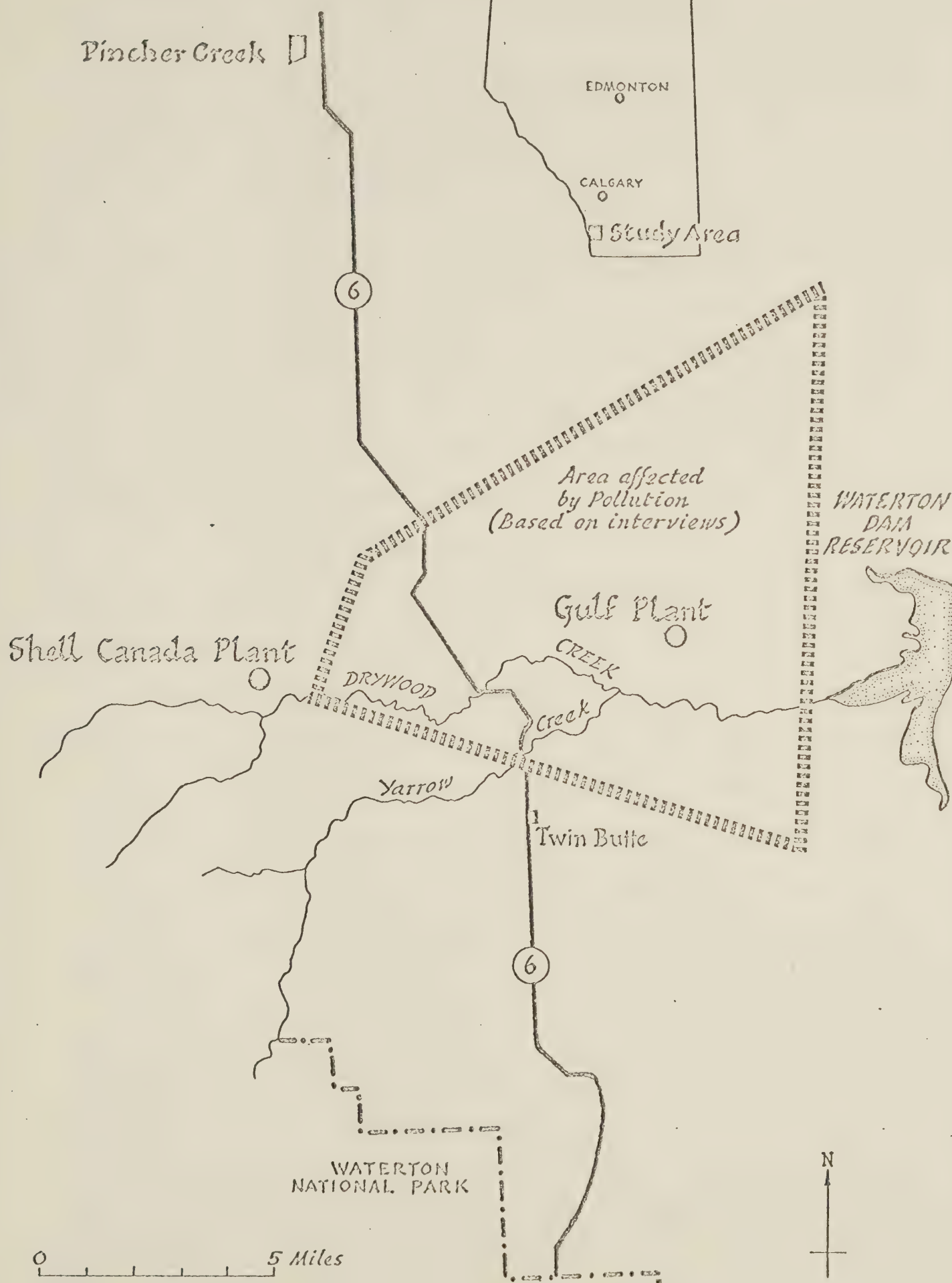
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PREFACE

This report reviews the research conducted to date by staff and graduate students of the Department of Geography, University of Alberta, toward finding an explanation for the health, social, and economic problems attributed to environmental pollution in the Drywood Creek ranching area of Southern Alberta (Map 1).

The present report has been compiled by M. Stick and P.A. Bonnett and is an extension of preliminary surveys undertaken by the 1969 Graduate Field Camp.¹

Dr. Don Gill
University of Alberta



INTRODUCTION

This day....no big bull trout lies
finning lazily in the cold, clear
current of Drywood Creek - not under
the falls of anywhere else along that
once marvelous trout stream. For the
stream is dead....²

In the late 1940's, commercial quantities of natural gas were proven in the Waterton-Twin Butte ranching area of the Municipal District of Pincher Creek. By 1957, the British American Oil Company (later Gulf Oil) had established a plant to process gas and extract 50,000 gallons of propane and butane and 675 long tons of sulfur per day. Shell Canada established their plant in the far more productive western field. Operations commenced in 1962, producing 6,500 barrels of pentanes and 1000 long tons of sulfur per day, with a design capacity of 8,000 barrels of pentanes and 1,500 long tons of sulfur per day.

With the commencement of production of the plants, some forty ranching families in the vicinity began to complain of discomfort from gas fumes; several individuals experienced recurrent illnesses which they attributed to concentrations of noxious gases originating from the gas plants. Livestock production at this time was similarly affected and there were reports of damage to property and machinery. Ranchers' complaints to Alberta Provincial Government authorities and to the companies were investigated and eventually dismissed as hysteria. In late 1966, incensed at what they considered to be unfair treatment at the hands of government and industry, some of the ranchers instituted legal proceedings to gain compensation for what they claimed was the unnatural way they had to operate land which had been in their families for up to three generations. After five years, this

lawsuit was terminated by the action of the oil companies who purchased an easement to continue the release of gas over the property of those ranchers who agreed to this procedure. Shell has consented to provide data to the ranchers in order that a check may be kept on the air pollution levels in the future. Some twenty-five to thirty families, however, who were not involved in this lawsuit, remain uncompensated, and in their view the pollution problem continues unabated.

In 1968, a second element of the pollution problem arose when members of two families in the area were found to be suffering from lead poisoning and traces of lead were found in wells, springs and streams. Industry disclaimed any responsibility for the water pollution and governmental investigations found no proof that water contamination existed.

FOCUS OF RESEARCH

Research initially focused on two aspects:

1. Information was gathered from ranchers on problems they attributed to air and water pollution, their attempts to prove the validity of their complaints, their efforts to gain compensation for damage, and their attitudes towards the efforts of governmental agencies in investigating the pollution problem.

2. Data on file at the Department of Health of the Provincial Government on stack and water effluent from the gas plants and on water and air pollution surveys was analyzed in an attempt to isolate possible pollution agents. When these data were scrutinized, nothing which could satisfactorily explain the situation at Pincher Creek was found. Thus another phase of research was instituted, the search for other possible contaminants not considered either by the ranchers themselves or the Department of Health. This phase of research is still in progress.

The work undertaken had a number of purposes:

1. to examine the nature and effectiveness of investigations of pollution problems by provincial agencies;
2. to examine the problems faced by a group of people who are convinced that they have little support from government agencies created to protect their well-being;
3. to suggest possible causes of the general ill-health suffered by members of the ranching community in question;
4. to aid communication between affected persons and the Department of the Environment and Department of Health in the hope that not only will the situation at Pincher Creek be alleviated but that any

future problems arising in other gas producing areas of Alberta may be sympathetically dealt with.

SOURCES OF INFORMATION

All data mentioned in this brief are either government-collected or provided by the ranchers in the area. We did not at the time of the investigation have access to monitoring data from the oil companies, but this situation is to be remedied in the immediate future.

Types of information included:

1. A preliminary investigation of the pollution problem was undertaken by three graduate students of the Department of Geography, University of Alberta, in 1969. This report was compiled from information filed in the Municipal District (MD) office at Pincher Creek and from interviews with ranchers in August of 1969.
2. A questionnaire (presented in Appendix A) was sent to ranchers early in 1971. The questionnaire was distributed in an attempt to obtain some formal documentation of the ranchers' complaints. Since only ten were returned, however, these may not be truly representative of the way people feel in the Drywood Creek region.
3. Data were obtained from the Division of Environmental Health Services of the provincial Department of Health including stack sampling from the Shell gas plant, liquid effluent samples for both Shell and Gulf, and air pollution survey reports. All of the information held by the Department of Health may not have been available for this study, however.
4. Correspondence and air pollution surveys held in the MD office at Pincher Creek were utilized.
5. Correspondence and reports held by affected ranchers were evaluated.
6. Water analyses which were conducted independently by one of the investigators and water analyses commissioned privately by some of the ranchers were examined.
7. Relevant newspaper reports were evaluated.

HISTORY OF THE POLLUTION PROBLEM

The first complaint on record concerning pollution of air in the Drywood Creek area was received by the Department of Health's Division of Sanitary Engineering on December 12, 1961. However, the secretary of the MD office in Pincher Creek reports that complaints have been voiced about air pollution from the Gulf plant since 1959. Similar complaints have been lodged against the Shell plant since 1962. Ranchers recall that there were escapes of raw gas from drilling operations in 1948 and that there were heavy fumes associated with a 100-day gas test in 1951. During 1958 and 1959, several ranchers made formal complaints to the Department of Agriculture concerning the effects that gas fumes were having on hog production. These complaints were investigated by the Veterinary Services Branch in 1959 and 1960 (see page 18).

Monitoring of air pollution by the Department of Health began in 1957 with the establishment of five detection stations for sulfur dioxide at the Gulf plant.³ Levels of SO_2 recorded over a three year period (1957-1960) were all less than 0.1 parts per million (ppm).

The receipt of the first official complaint in December, 1961, produced an investigation by the Department of Health and the compiling of a report.⁴ The report merely concluded with a recommendation that air pollution in the area be monitored even though that department had been monitoring air pollution in the area for four years. Following further complaints from three ranching families, mobile monitoring trailers and apparatus were put into operation in January of 1962.

Table I shows that the number of surveys was greatest in the years 1963-64 and that this number has recently dwindled to one or two per year. Although forty families have registered complaints with Environmental Health Services (EHS) at one time or another, only twenty surveys in all have been conducted in ten years. The ranchers' claim that their complaints received insufficient attention may thus be valid.

Monitoring of the stack effluent at Shell under the direction of the Department of Health was begun in 1963 and has continued until the present at the rate of one sample per year.

During 1962, the ranchers organized themselves into an Industrial Pollution Committee. In the same year, the Department of Health appointed a Scientific Advisory Group to investigate the problem. Matters culminated in a hearing in Pincher Creek in November, 1962, with members of the government, company representatives, physicians, veterinarians and ranchers present. The only significant outcome of this appears to have been the stationing of a mobile trailer to investigate complaints on a 24 hour basis during 1963.

Except for the year 1963, there are no formal records of complaints available. In that year, 582 complaints were received by the secretary of the Industrial Pollution Committee and 78 by the operator of the trailer. Records of complaints pertaining to livestock losses, intolerable fumes and illness were lodged during the months of July, September and October of 1964 in the MD office at Pincher Creek, but the sequence or the intensity of complaints after this is not known.

During 1963, the Scientific Advisory Group studied the effects of fumes on local vegetation, gardens and field crops, and made meteorological studies in the area. Late in 1963, a physician on this committee

TABLE I. NUMBER OF AIR POLLUTION SURVEYS CONDUCTED
IN THE DRYWOOD CREEK AREA BY THE GOVERNMENT

<u>Year</u>	<u>No. of Surveys</u>	<u>Monthsof Survey</u>
1962	2	January, December
1963	4	January, February, March, September, October, November
1964	5	March, April, May, September, October, November, December
1965	1	September
1966	2	February, March, August, September
1967	2	June, July, November
1968	2	July, November, December
1969	1	August
1970	1	May

stated that "the committee had not been able to relate the symptoms (of the ranching families) to the possible causes as a result of air pollution. Several of the symptoms such as skin disorders, diarrhoea, coughs, headaches, etc., are common in southern Alberta, and are sensitized by worry or concern; some of the symptoms could be related to hyper-sensitivity."⁵

The end of 1963 brought the confrontation between the ranchers and industry/government to a head. In December 1963, the Industrial Pollution Committee accused the Department of Health of ignoring considerable correspondence from the ranchers, withholding information on the pollution problem, staffing the mobile trailers with operators unqualified for the task, and generating a complete lack of confidence in the governmental investigations. The Department was therefore advised that legal proceedings were being instituted against the companies involved.⁶

A majority of ranchers in the affected area regarded the registering of complaints with the Department of Health as a futile exercise, since they felt their pleas were being ignored. While it is now generally thought that the air pollution had undergone considerable abatement, ranchers are emphatic that it still remains a problem.

In September, 1968, the Edmonton Journal⁷ reported that two families in the Pincher Creek gas area were suffering from lead poisoning and that the ranchers were blaming ground water contamination by the drilling operations of the two companies. Fears of water pollution existed since at least the year before when ranchers had submitted water samples to the Provincial Analyst to test for lead. Three water sources showed lead in quantities at or below the provincial safety limit of 0.05 ppm. The

The Environmental Health Services Division of the Department of Health and the Chinook Health Unit (Fort MacLeod) jointly analysed the water sources of the area and took urine samples from 124 people. The conclusion reached was that there was 'absolutely no cause for concern as to the safety of water supplies with respect to lead content'⁸. This apparently closed the water pollution issue as far as EHS was concerned.

During 1968-1969 ranchers' representatives questioned Gulf and Shell about the possibility that they were contributing to lead pollution in local waters. Gulf reputedly analysed drilling muds, plant effluents, processing chemicals, and 19 domestic water supply samples for lead and came up with nil values.⁹ Shell replied that while no analysis for lead was regularly performed on plant effluent, no lead was present in typical analyses. In March of 1970, Shell had samples of its effluent analysed for lead and the values for 14 samples were all less than 0.03 ppm.¹⁰

The serious illnesses being experienced by a number of ranchers (kidney trouble, loss of vision for long periods, paralysis, and muscular wasting) they attributed to water contamination. This culminated in efforts to prove for themselves that contamination actually existed. This they attempted to do by having analyses conducted independently and at a high cost. As yet, analyses of domestic water, plant effluent, snow and sulfur from the stockpiles do not provide conclusive evidence that lead contamination is a positive threat.

It should be emphasised that many of the quoted values of lead concentration may well be invalid. All samples presumed to contain heavy metals require very careful collection and storage prior to analysis. It is unclear from the information available whether adequate care was taken to standardize procedures in the various analyses performed and thus it is difficult to make any definite statements regarding environmental levels of lead in the area

PROBLEMS ATTRIBUTED TO POLLUTION BY RANCH FAMILIES

Of foremost concern to the ranchers of the area are the more conspicuous effects of air and water pollution: discomfort, ill-health, loss of livestock, damage to crops and property, and in more than ten cases, families being forced to leave their homes. The issue is even larger than this. Psychologically, this group of people has developed a complete lack of confidence in the operation of the Division of Environmental Health Services (EHS) and a scepticism that investigations of their situation are biased against them. These ranchers feel that they have been forced to their own devices in proving the validity of their problems, and they are convinced that the workings of pollution control programs in this province can be called to question.

Health Problems Attributed to Air Pollution

As discussed previously, records of complaints for 1963 are available only and these are presented in Table II. In order of number of complaints, the health problems which the ranchers attributed to air contamination are: headache, insomnia, skin irritation, throat irritation, eye irritation, stomach cramps, lassitude, nausea, nose bleeds, diarrhoea, loss of appetite, anaemia, loss of the sense of balance, and no weight gain in children. As well, The Lethbridge Herald (October 31, 1962) reports that ranchers experienced dizzy spells or collapsed in their fields when gas fumes became overpowering.

But for the last, the health problems suffered by the ranchers are certainly not unique and it may be, as one physician has claimed, that such symptoms are endemic to southern Alberta.

TABLE II. NATURE OF COMPLAINTS DURING
JANUARY - NOVEMBER, 1963

<u>Complaints</u>	<u>To Industrial Pollution Committee</u>	<u>To Health Depart- ment Trailer</u>
Odour	443	71
Sulfur dust	14	3
Headache	102	31
Nausea	34	26
Nosebleeds	18	4
Insomnia	41	14
Lassitude	38	4
Stomach ache	26	3
Diarrhoea	10	1
Skin irritation	37	4
Eye irritation	30	22
Nose and throat irritation	42	21
Loss of appetite	11	8
Others	111	31
TOTAL complaints received	582	78
ABSOLUTE TOTAL	957	243

No proof of this claim by way of control studies has been furnished, however. Most doctors consulted by the ranchers are sympathetic to their problem but can locate no tangible proof that ill-health is being caused directly by air pollution. Their only suggestion for relief has been that badly affected families should leave their land. Children with eye problems have been sent to a specialist in Lethbridge who stated that the soreness was definitely caused by a chemical irritant and was not caused by infection. The results of the Air Pollution Surveys conducted by the Department of Health (which tested for SO_2 and H_2S) indicated only harmless quantities of these gases in the atmosphere, however. The medical officer of the Chinook Health Unit was reportedly looking for other noxious substances which could be responsible¹¹ but the results of his work are not known.

Health Problems Attributed to Water Pollution

Because of the seriousness of the health problems attributed to it, water pollution has created a great deal of fear in the Drywood Creek area. The list of illnesses which ranchers believe to be the result of water contamination is one case each of:

- loss of both kidneys (male in mid-thirties)
- complete debilitation, loss of full vision,
power of speech, and normal movement (male in
mid-thirties)
- temporary paralysis
- temporary loss of vision
- severe allergy to domestic water in the form of
nausea and swelling

-stomach cramps and nausea when water from a local source was used (this affected an entire family).

Stomach cramps are apparently widespread in the ranching community, a problem doctors have diagnosed as 'flu'. The death of two men in their sixties (one of whom suffered recurrent stomach cramps before his death) was not attributed to water pollution although both lived on Drywood Creek.

The Department of Health's study of suspected lead poisoning in the area in 1968 included the analysis for lead in 75 water samples from the water supplies of 43 families and in 124 urine specimens from 31 families. The initial result was that 6 water samples and 17 urine specimens showed lead content above the normal limit. Repeated analyses on the samples showed that all finally were below the acceptable limits.

Water analyses conducted independently by the ranchers are shown in Table III. While some samples show abnormally high concentrations of lead, e.g., in the Shell effluent, in some wells and in snow, the results are not constantly high and Shell's testing for lead directly refutes the ranchers' results. The time that samples were taken could explain this discrepancy, but whereas Shell kept a record of their sampling time, the ranchers could provide no accurate record of this. Ranchers are sceptical of the validity of tests performed by the Department of Health since it is claimed that samples taken were often too small and that the final results of the Department's analyses were not made available to the families involved.

TABLE III. WATER ANALYSES

<u>Date</u>	<u>Sample location</u>	<u>As</u>	<u>Se</u>	<u>Hg</u>	<u>Pb</u> (ppm)
September, 1968	well	-	-	-	0.05
October, 1968	spring	-	-	-	nil
	well	-	-	-	nil
January, 1969	well	-	-	-	0.04
March, 1969	creek	-	-	-	0.03
	well	-	-	-	0.05
January, 1970	Shell effluent	-	-	0.01	0.2
March, 1970	well	-	-	-	0.06
March, 1970	Shell effluent (14 samples)	-	-	-	<0.03
March, 1970	Shell effluent	<0.05	<0.1	-	0.04
April, 1970	Shell effluent	<0.05	0.015	-	0.02
June, 1970	well	-	-	-	0.03
January, 1971	well	<0.01	0.001	-	nil
January, 1971	well	-	-	-	0.04

The Threshold Limit Value (TLV)¹²-for lead is 0.05 ppm

-for selenium is 0.01 ppm

-for arsenic is 0.05 ppm

To avoid further ill-health and because they feared the consequences of using local water sources, some ranchers left their properties to live in the town of Pincher Creek and commuted daily to work their land, while others began to haul water for drinking and bathing from the town of Pincher Creek or from Waterton National Park.

As with air pollution, it is difficult to prove a direct link between water contamination and the serious illnesses recorded at Pincher Creek, especially when water analyses do not prove conclusively that there is a sufficient level of contamination. However, a diary of events recorded by one family shows that whenever ranch well-water is used for drinking or bathing, their youngest daughter develops a severe allergy which disappears when she enters hospital for treatment, while the rest of the family experience varying degrees of nausea and stomach trouble until water from an outside source is again used.

Economic Problems Attributed to Pollution

Damage to property and machinery in the form of peeling paint and rapid rusting or corrosion are universal complaints among the ranchers. Crops and garden plants have been badly burned (presumed by ranchers to have also been caused by fumes) but such problems are not regarded as seriously as are the recurrent livestock losses attributed to both air and water pollution.

During 1959, complaints from farmers that hogs were being affected by fumes from the Gulf plant prompted an investigation by the Department of Agriculture.¹³ It was reported that healthy hogs were dying overnight from lung damage, apparently caused by fumes. The Department of Agriculture investigation involved the experimental exposure of hogs to SO_2 and H_2S for periods of from three hours to six weeks and observation

of the effects for over two months after. H_2S was found to have no significant effect on the animals tested. SO_2 in concentrations of 10 ppm or more for 3-1/2 - 7-1/2 hours produced lung damage, respiratory tract problems, and impaired growth rate. It was shown that these symptoms corresponded to those of hogs examined at one of the ranches in the polluted area. There is no evidence that any formal action was taken by the Provincial Government following this report. It appears that the situation continued to deteriorate as the veterinarian in Pincher Creek stated in late 1962 that almost the entire Pincher Creek district had gone out of hog production as hogs were most susceptible to pollution.¹⁴

There are no formal records of livestock losses, and reports of losses from individual farmers are often contradictory. From newspaper reports it seems that losses of 5-13 cattle could occur on ranches when the fumes from the gas plants were strongest. For example, in late 1962, one rancher reported that he had lost a total of seven calves and three cows; another reported in September 1964 that he had discovered five cattle dead in one day from what was diagnosed as pulmonary emphysema. In addition to actual loss of cattle, it was veterinary opinion that air pollution was stunting growth and that fattening time had been lengthened (The Lethbridge Herald, November 15, 1962).

One rancher in the area claims that his cattle will not drink from Drywood Creek unless forced to by the freezing of water at other sources. In late 1969, his cattle did take their water from the creek and developed sicknesses such as staggering, general lack of muscular coordination, and blindness. Over the next six months the rancher lost seven of these cattle. The fifth to die was taken for autopsy by the local veterinarian to the Provincial Laboratory. The analysis showed that

the animal had excessive bloat, an obnoxious smell, an accelerated rate of decomposition for the length of time since death, and excessive brain damage. Apparently these symptoms could not be related to any known contaminant in the water. The same ranch family became ill without any obvious reason in February and March of 1971. When they stopped eating the meat of an animal butchered at the beginning of February, their symptoms disappeared. The family believes that because this animal had been drinking from Drywood Creek for five months before it was butchered, its meat contained contaminants from the water.

We were unable to find any evidence that the Department of Agriculture has performed any formal investigation of the susceptibility of cattle to air and water contaminants possibly present in the Drywood Creek area, a problem which has received little of the attention that it warrants.

When the livestock economy of an area is threatened, when normal water supplies are not used, when ranchers commute rather than live on their properties, and when those who remain on the land do so at considerable discomfort, it is quite obvious that one economic aspect which will outlive any pollution problem is lowered land value. Ranchers estimate that land has lost from 10% to 40% of its value in the vicinity of the gas plants.

Social Problems Attributed to Pollution

Two of the most obvious social problems generated by pollution are the disruption of normal family life caused by illness and by such inconveniences as having to carry all water from a considerable distance, and the disruption of normal community life by eleven families

being forced from their homes.

Less obvious are problems generated during the past fourteen years by the psychological climate in the Drywood Creek region. People no longer feel confident that the provincial government is sincere in its attempts to solve the pollution problem. This is partially evident in the fact that ranchers no longer bother to register formal complaints with the government. Neither do they believe the credibility of industry when it claims that it is doing everything possible to maintain effluent within safe limits. Some ranchers indicated they had even begun to suspect the loyalty of their representatives in the lawsuit. Before the recent out-of-court settlement, Shell twice offered a similar compromise and each was rejected, but it nevertheless caused friction between those who were agreeable and those who wished to continue the suit.

While the government may feel that concrete evidence for pollution is lacking, the events up to now have convinced the residents of the Drywood Creek area that there is a pollution problem which needs comprehensive and co-ordinated research that the government has not yet fulfilled. The adequacy and relevance of the 20 air pollution surveys and the single water pollution survey on which the Department of Health bases its dismissal of the situation is questioned by the people of the area. The fact that the ranchers have been forced to utilise their own resources to prove their case and gain compensation for damage is a situation which they feel should not be permitted to exist.

GOVERNMENT MONITORING SURVEYS FOR AIR POLLUTION

Types of Pollutants Measured

Data provided by the Department of Health on air pollution monitoring indicates that in the 20 surveys conducted between 1962 and 1970, the only contaminants tested were SO_2 and H_2S . These were the only contaminants that ranchers complained of, but it was unfortunate that sampling was not extended to include other potentially dangerous pollutants, such as nitrogen dioxide and carbon disulphide, which may be emitted from gas plants.

Results of the Surveys

Examples of the concentrations of SO_2 and H_2S detected by the surveys are shown in Tables IV-VI. These figures are typical of every survey and show that high concentrations of SO_2 and H_2S were never detected. The low concentrations measured do not adequately explain the recurrent symptoms of ill-health displayed by the ranching community.

Concentrations of H_2S which produce symptoms of sickness such as those experienced by the ranchers are as follows:¹⁵

20-150 ppm - irritation of eyes

>150 ppm - irritation to respiratory system

20-150 ppm for repeated exposures:

- blurred vision

500 ppm exposure for 30 minutes:

- dizziness, staggering, nausea, diarrhoea

800-1000 ppm - fatal within 30 minutes

TABLE IV. CONCENTRATIONS OF SO₂, AS MEASURED BY
 DAVIS ANALYSER, 1962

<u>Date of Occurrence</u>	<u>Duration (minutes)</u>	<u>Highest Recording (ppm)</u>
January 1 - 31	370	>0.1
January 1 - 31	45	>0.1
February 1 - 16	75	0.05 - 0.057
February 1 - 16	951	0.1 - 0.19
April 12 - 30	29	0.4 - 0.49
April 1 - 12	47	0.03 - 0.039
April 12 - 30	285	0.01 - 0.09
May 9	5	0.2 - 0.29
May 9	50	0.01 - 0.019
December 3 - 20	52	0.06 - 0.1

TABLE V. CONCENTRATIONS OF H_2S , AS MEASURED BY
SPOT SAMPLER, 1963

<u>Date of Occurrence</u>	<u>No. of Samples</u>	<u>Recording (ppm)</u>
January 5 - 26	1	0.0001 - 0.009
January 26 - February 18	37	0.0001 - 0.009
March 8 - 16	33	0.0001 - 0.009
September	6	0.0001 - 0.009
October	8	0.0001 - 0.009
November	16	0.0003 - 0.0013

TABLE VI. CONCENTRATIONS OF SO₂, AS MEASURED BY
TITRILOG, MARCH, 1964

<u>Date of Occurrence</u>	<u>Peak Concentration (ppm)</u>	<u>Duration (minutes)</u>
9	.24	5
10	.12	8
	.24	6
	.48	9
	.24	7
25	.12	2
	.48	6
	.24	3
	.12	3
	.12	2
	.24	5
	.24	4
	.24	4
	.12	4
27	.12	4
	.24	5

For SO_2 the concentrations producing symptoms of ill-health are:

- <1 ppm - injurious to plant foliage
- 3 ppm - detectable by odour
- 6-12 ppm - irritation to respiratory system
- 20 ppm - irritation to eyes
- 50-100 ppm - collapse if exposure for 30 minutes
- 400-500 ppm - immediately fatal

If one compares the ubiquitously harmless concentrations of SO_2 and H_2S detected at Pincher Creek with those needed to produce the symptoms of the ranchers then the two conclusions which may be reached are that illness is being caused by contaminants for which tests were not run or that faulty surveying by the monitors failed to record the actual levels of those contaminants tested.

Equipment Used in the Government Surveys

The detection equipment placed in the field is as follows:

1. 15 exposure cylinders
 2. sticks painted with white lead
 3. spot samplers for H_2S
 4. titrilogs
 5. conductivity analysers
 6. Davis analysers
-) SO₂

Some of the factors outlined below indicate that these instruments may not be capable of measuring the critical concentrations which cause illness.

1. Exposure cylinders: These may be operated either by colorometric methods or by weight methods. Filter paper impregnated

with a reagent traps or is discolored by contaminants and the degree of discoloration is a measure of the accumulated contaminant. The reading is averaged to give a figure for each day in the sampling period which is usually a month. There are three criticisms of the use of cylinders in the Drywood Creek area: doubt has been expressed by ranchers that the filter papers are changed every month; dust readily accumulates on the paper and interferes with its interpretation; the method does not allow for the measuring of the level and time of critical peak concentrations thus only an average value is obtained; it is also dubious whether an average for each day is valid since not every day of the month will have the type of meteorological conditions which cause concentrations of pollutants.

2. White lead indicators provide information only on the presence of gas and they are vulnerable to interference by dust.

3. The H_2S spot samplers are operated over sample periods (in this case three hours) with the amount of discoloration of lead acetate on filter paper giving the accumulation of H_2S during that period. Air must be passed through the paper and the results will be low if the sampler is only exposed to air.

4-6. The titrilog, conductivity analyser, and Davis analyser are continuous recording devices which should record the peaks and duration of SO_2 . The data supplied by the Health Department were of a secondary source and the original pen traces were not available for

inspection. Ranchers have claimed that some of the traces ran off the top of the graph paper but in no way did the secondary data show this.

Instrument Positioning

The positioning of sampling equipment has been criticised by ranchers as being irrelevant to what would be a true sampling of atmospheric conditions. Critical to the positioning of sampling equipment are local topography and meteorological conditions:

1. Heavy gases concentrate in depressions and equipment stationed elsewhere may not record such damaging concentrations.
2. Fumes may be concentrated in topographically-induced currents or conversely, stagnant air may likewise cause concentrations.
3. Gas concentrations may cause greater problems during humid periods which cause the acidification of sulfur gases.

Air pollution monitoring by the Department of Health does take account of meteorological conditions but only to the extent of taking wind direction and speed measurements. What results is a correlation of wind direction and speed with occurrences of SO_2 and H_2S which merely proves that the source of pollutants is to the west of the contaminated area. Because of the small concentrations of the gases recorded, attempts to correlate gas occurrence with wind speed are not meaningful.

Two other conditions of the sampling procedure should be considered. With the limited amount of equipment in the field, many of the ranchers' complaints could not always be investigated. Furthermore, the vagaries of meteorological conditions in the area makes it

quite possible that monitors were measuring harmless concentrations at one place while harmful concentrations were being experienced elsewhere. Secondly, the equipment could not always be placed in areas where heaviest concentrations of gas were noticed since an external power source is needed to operate it.

Stack Monitoring Conducted By The Government

Monitoring of the stack emissions at the plants is performed once annually, usually over a two day period. The emissions of SO_2 and sulfur at one plant are graphed in Figures 1 and 2. Three out of the seven sampling periods (June 1966, July 1967, and June 1969) show emissions of sulfur above the Provincial Board of Health Approval limitation of 100 long tons per day. If this occurs during a pre-warned sampling run then emissions could conceivably be different during other periods. The emissions of SO_2 from the stack samples are of such a volume that concentrations of the fumes caused by topography or wind currents could be toxic. Within the last two years, the monitoring survey has included calculations of the concentrations of SO_2 at ground level taking into consideration the rise of gases, wind velocity, and distance downwind. None of these estimations consider that gases may be concentrated by meteorological conditions such as temperature inversions, with the result that all estimates show harmless amounts of gas at ground level.

FIGURE 1:
SHELL STACK SAMPLING : EMISSION OF SO_2

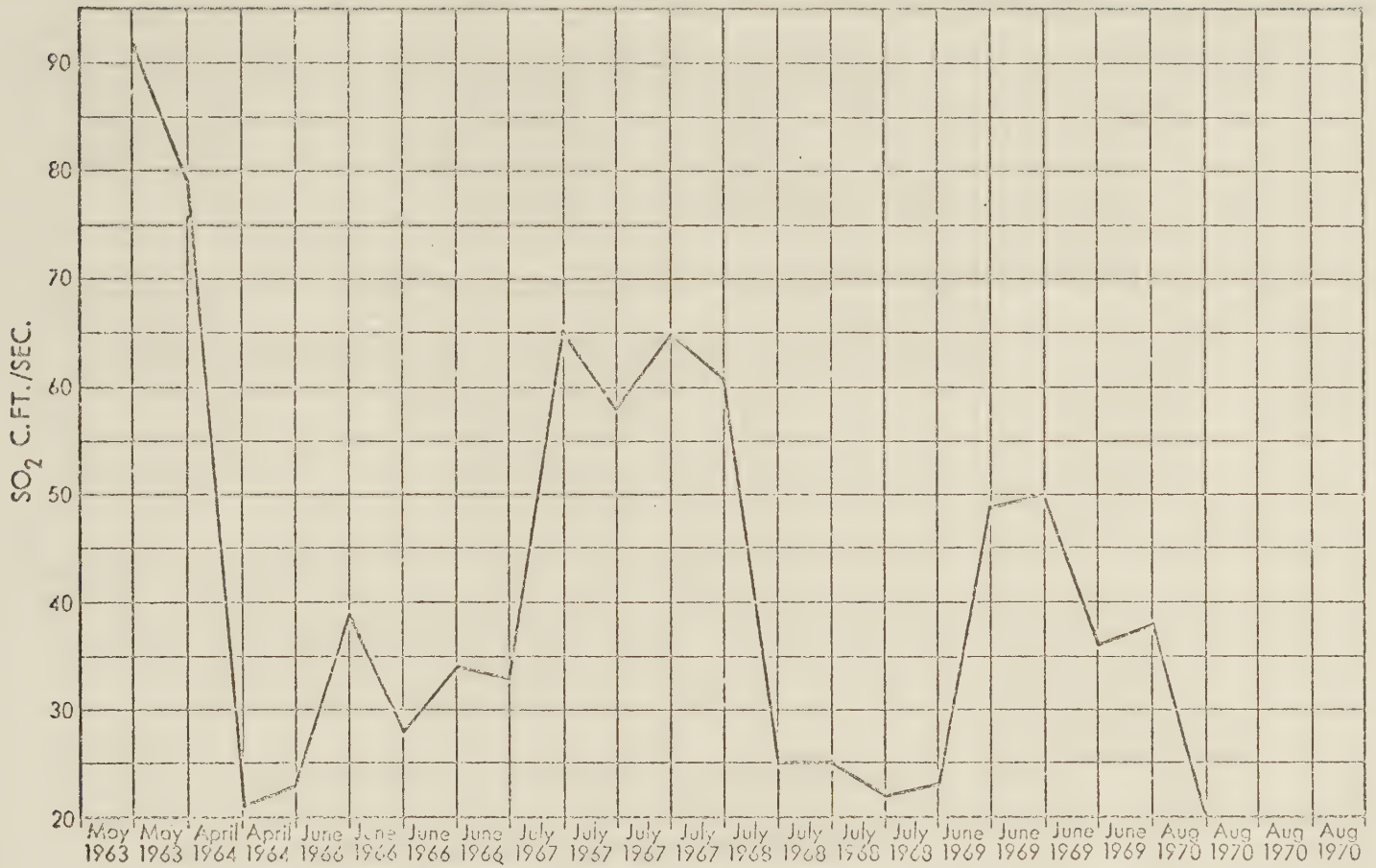


FIGURE 2:
SHELL STACK SAMPLING : WEIGHT OF SULPHUR DISCHARGED



GOVERNMENT MONITORING SURVEYS FOR WATER POLLUTION

While complaints about air pollution produced a number of monitoring surveys, it appears that complaints about water pollution produced only one attempt to sample domestic water supplies. The actual liquid effluent from the plants is monitored more often, however, usually once to three times annually. Figures 3-5 show the types of contaminants measured at one plant and the months when samples were taken.

Several aspects of these data and of the monitoring system may be criticised:

1. The number of samples taken per year is inadequate.
2. The number of contaminants tested for is inadequate, being restricted to chlorides, sulphates, oils and greases, H_2S , phenolics, and Biochemical Oxygen Demand (BOD). Lead, bromine, arsenic, and selenium, for example, are not tested for in the sampling even though these have been found in abnormal quantities in local domestic water supplies.
3. Sampling of the contaminants which are tested is erratic over time. Note in Figures 3-5 that effluent constituents were not consistently or fully tested during the sample period.
4. Pollutants sampled in the effluent are often much higher than the Threshold Limit Value,¹² e.g., BOD, phenols, oils and greases, and sulphates, and the Alberta Government approved limits for BOD (Figure 3).
5. The sample taken is a spot sample and since the flow of effluent is variable, the validity of extrapolating information from one spot sample to year round conditions is questionable.

FIGURE 3:
SHELL GAS PLANT, FINAL EFFLUENT CONSTITUENTS

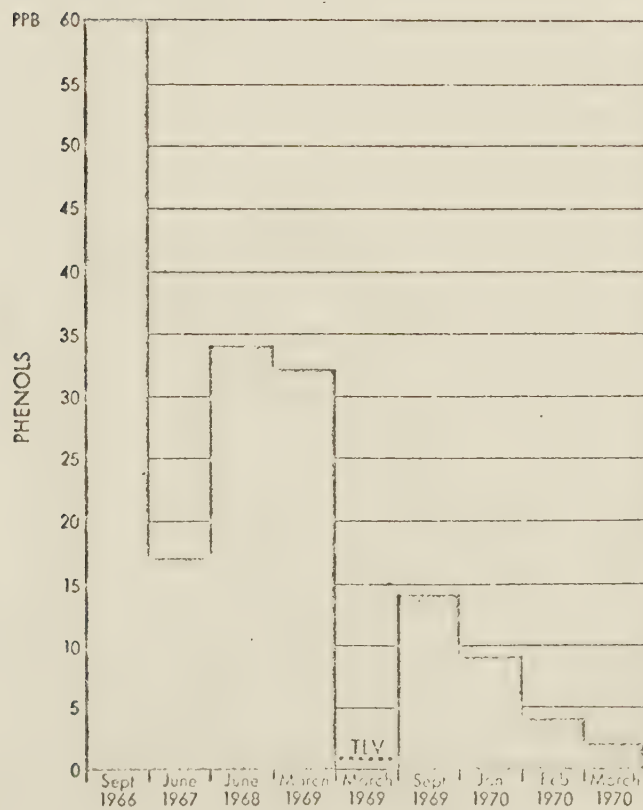
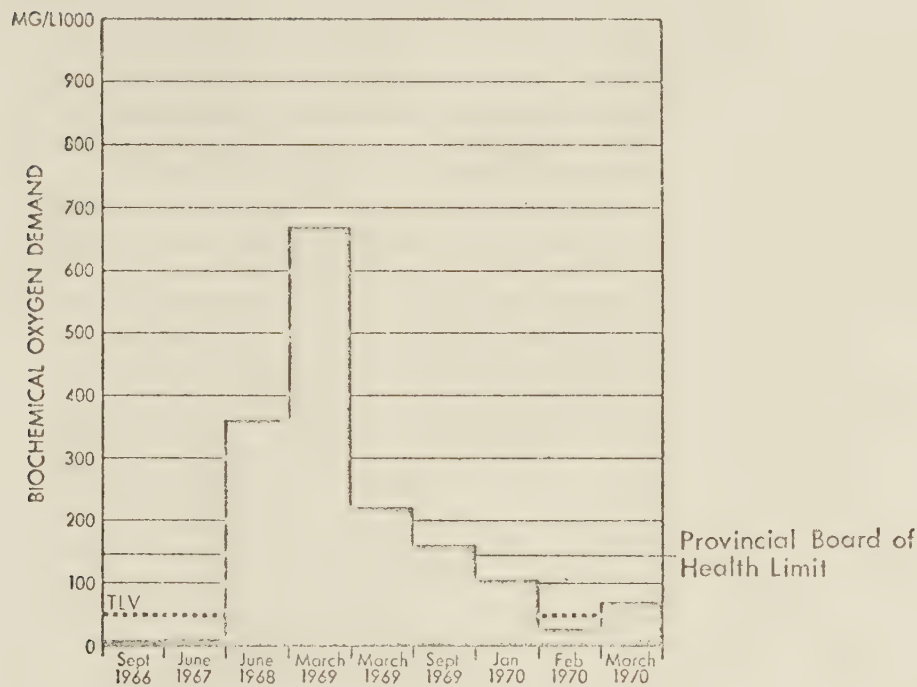


FIGURE 4:
SHELL GAS PLANT, FINAL EFFLUENT CONSTITUENTS

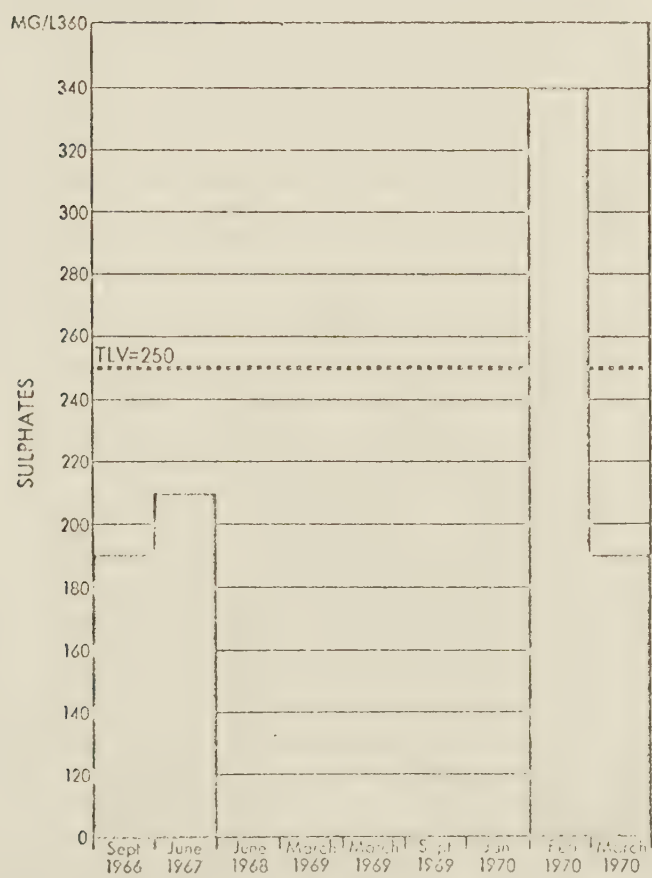
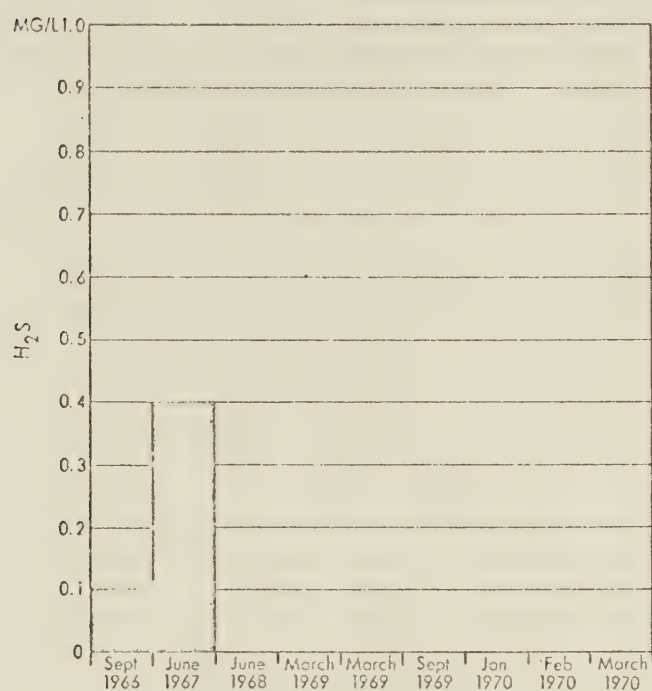
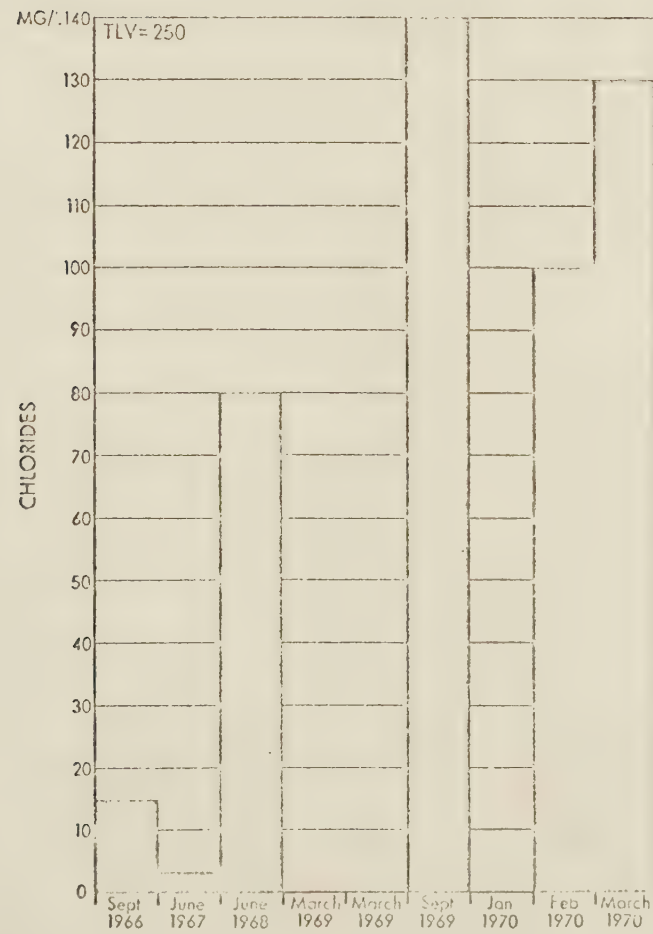
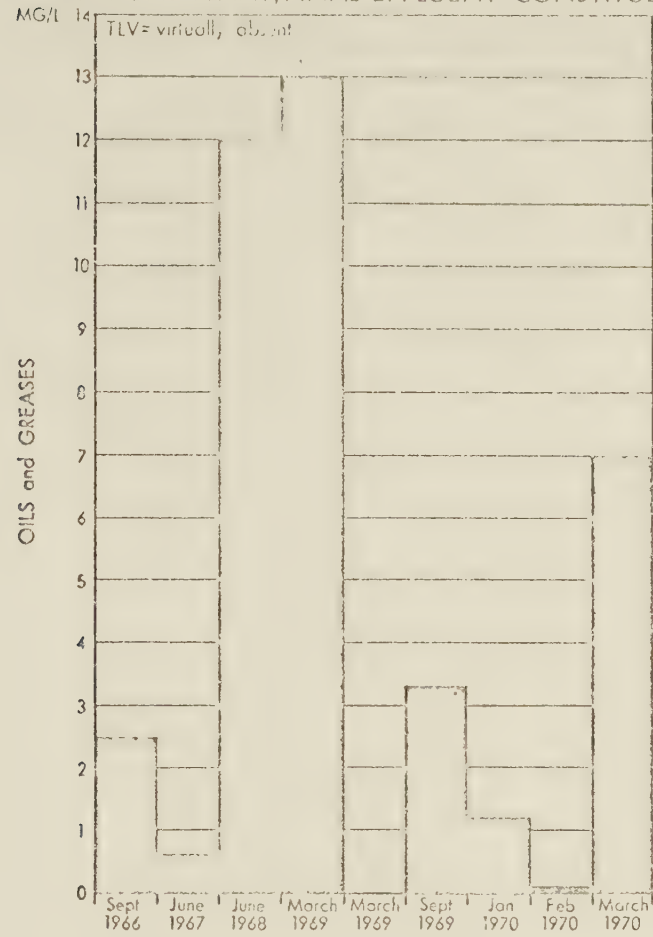


FIGURE 5:
SHELL GAS PLANT, FINAL EFFLUENT CONSTITUENTS



6. Little account is taken of the dangers of discharging effluent into Drywood Creek which has a relatively small discharge, particularly during late winter when flow is greatly diminished.

OTHER POSSIBLE FACTORS CAUSING HEALTH PROBLEMS

One of the main criticisms to be levelled against the government investigations of pollution is that only the three most obvious contaminants have been tested for: lead, H_2S , and SO_2 . Examples are given below of other pollutants which could produce symptoms that ranchers have experienced:¹⁶

1. Carbon disulphide is a possible emission from gas plants. The tolerance level is 20 ppm in air. Chronic exposure to the gas produces disturbance to vision, chronic fatigue, depression, and damage to the nervous system.
2. Phenols may be inhaled, ingested, or absorbed through the skin. The tolerance level in air is 5 ppm and in water, 0.001 ppm. Symptoms produced by phenolic poisoning are headaches, dizziness, dimness of vision, nausea, abdominal pain, kidney damage, and damage to the central nervous system.
3. Selenium is analogous to sulfur in many of its chemical combinations and in natural gas products it is possible that hydrogen selenide is present. H_2Se in air in concentrations as low as 0.2 ppm produces toxic symptoms. Selenium concentrations in water of over 0.01 are toxic. Selenide poisoning of livestock commonly produces a disease known as 'blind staggers' with impairment of vision and weakness of limbs. In human beings chronic exposure to H_2Se produces nervous disorders, depression, anaemia, digestive disorders and possible kidney damage.

The problems of finding other causal agents is complicated: more than one element or compound may be responsible for illnesses in different people; many elements, especially the heavy metals, can produce the same symptoms; the presence of one element may increase the toxicity of another; the complete chemical composition of the natural gas in this area is not known; the complete composition of the stack emissions and effluent is not known.

CONCLUSIONS

1. The investigations of health and economic problems and the sampling and monitoring of pollutions levels conducted by agencies of the Provincial Government has not been as comprehensive as warranted by the apparently complicated nature of the pollution problem in the Drywood Creek region.

2. The evidence, which admittedly has not always been gathered from formally documented sources, suggests that the people in the Waterton and Twin Butte gas fields have received less than adequate help and support from the Government of Alberta. No recent attempt has been made to conduct a comprehensive investigation designed to integrate the findings of separate government departments.

3. It has not been possible to define any causes for the ill health experienced by people in the Drywood Creek ranching community. Until an integrated investigation of health problems and possible causes is instituted, the causal factors are unlikely to be identified.

4. The authors hope that the presentation of this brief will serve to acquaint the public with the distress of these people and to prompt the Government to investigate this problem in a manner designed to discover the causal factors. Previously, Government response to suggestions and evidence offered by the affected families has been largely negative. The probability exists that other gas plants in the Province will produce similar problems and thus many more people may be bearing a cost for which they are not fully responsible.

RECOMMENDATIONS

This brief has outlined the results of research to present on the pollution issue on the Drywood Creek area. To complete this work, it is recommended that the following minimum procedures be followed:

1. The survey of domestic water supplies which was initiated by the Energy Resources Conservation Board should be continued.
2. The meat of beef cattle thought by ranchers to be responsible for illness should be tested by the Department of the Environment.
3. The original pen traces of instruments used to monitor H_2S and SO_2 should be made public.
4. Substances condensed on emission stacks should be sampled and analyzed by the Energy Resources Conservation Board.
5. The work of personnel in the Department of Agriculture and in the Lethbridge Agricultural Research Station should be made public.
6. Inquiries should be made by appropriate provincial departments in the Stettler and Harmatton-Elkton gas producing areas to ascertain if similar problems exist there.

Acknowledgements

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FOOTNOTES

1. Mead, R., N. Ward, and P.A. Bonnett, 1970. The Pincher Creek Sour Gas Industry: A Study in Environmental Pollution. Unpublished report, Department of Geography, University of Alberta.
2. This quote taken from Andy Russel's book Trails of a Wilderness Wanderer (Alfred A. Knopf, Inc., New York, 1971, 298p.) indicates the strength of feeling of those who have been born and raised in the area of Pincher Creek. Recent surveys by the Fish and Wildlife Division suggest that technically speaking the stream is not completely dead.
3. Summary of Pincher Creek Air Pollution Control Program, Department of Health, 1960.
4. Air Pollution Complaint, Pincher Creek, December 21, 1961, Department of Health.
5. Minutes of the Scientific Advisory Committee, December 3, 1963.
6. Correspondence, Industrial Pollution Committee, December 3, 1963.
7. Edmonton Journal, September 23, 1968.
8. Summary of investigations into possible lead contamination in the Pincher Creek area, Department of Health, February 5, 1969.
9. Correspondence: A. McRae/Gulf, December 24, 1968.
10. Correspondence: R. Yakubiec/Shell, February 13, 1969.
11. Lethbridge Herald, June 20, 1963.
12. TLV (Threshold Limit Values) taken from the surface water criteria for public water supplies of the Report of the Committee on Water Quality Criteria, Federal Water Pollution Control Administration, U.S. D.I., 1968.
13. Correspondence, F. Bonertz, Department of Agriculture, October 24, 1960.
14. Lethbridge Herald, October 31, 1962.
15. Sax, I.N., 1968. Dangerous Properties of Industrial Materials, Reinhold, N.Y., Third Ed.
16. Sax, I.N., 1968. Dangerous Properties of Industrial Materials, Reinhold, N.Y., Third Ed.

APPENDIX

QUESTIONNAIRE USED IN SURVEY

(Compiled by M. Stick)

A. GENERAL

1. Do you consider that air contamination is a problem in the area at present?
2. Do you consider that water pollution is a present problem?
3. How many families have left the area specifically because of a threat to their health from pollution?
4. (a) Has your land lost resale value because of the reputed pollution problem in the area?

(b) If so, can you give an estimation of the decline in value? (i.e. 10%, 50% etc.)

B. HEALTH PROBLEMS

1. What ill-health in your family do you attribute to
 - (a) air pollution?
 - (b) water pollution?(Please give an approximate date when symptoms were first noticed).
2. Which of these health problems have caused you to seek medical advice?
3. What explanation did the physician offer for your illness?
4. If the physician attributed your illness to air or water contamination, were any tests taken to confirm this? (Please specify which tests.)
5. What potentially harmful substances were revealed by such tests?
6. Have you submitted the test results to government, oil companies or legal authorities for inspection?
7. Did the authorities ever fail to return the test results to you?
8. Have any medical practitioners ever offered to support your case in legal proceedings?

C. PROPERTY DAMAGE

1. Comment on the extent of damage, which you attribute to air or water pollution, of the following property items:
 - (a) crops
 - (b) grazing land

- (c) trees
- (d) livestock
- (e) buildings

2. Have you sought confirmation of the source of damage from any qualified agriculturist, botanist or veterinarian?

If so, please specify:

- (a) the type of damage investigated.
- (b) the results of the investigation (if known).

3. (a) Are you still in possession of the formal document showing the results of these investigations?

(b) If not, who now has them?

D. RESEARCH

1. Has any medical practitioner ever volunteered to investigate the effect that water or air pollution has had on your health?

If so, (a) specify the nature of his research interests (i.e. kidney, respiratory, heart diseases, etc.)

(b) specify the conclusions he reached.

(c) indicate whether his interests in the project lapsed before the investigation was completed to your satisfaction.

2. Has any agriculturalist, soil scientist or any research station approached you with the intent of conducting research into the effects of pollution on your property?

If so, (a) specify the type of research.

(b) specify any results from the research of which you are aware.

3. Have either of the two oil companies conducted any type of soil, veterinary or health research on your property?

If so, (a) indicate the type of investigation undertaken.

(b) indicate any results of which you are aware.

4. Has the Environmental Health Services (E.H.S.) section of the provincial Dept. of Health, or any other government department, conducted any soil, veterinary or health research on your property?

If so, (a) what type of research was conducted?

(b) were any results revealed to you?

E. LEGAL PROCEEDINGS

1. (a) Have you privately attempted to gain compensation from the companies involved for:
 - (i) property damage
 - (ii) health damage
 - (iii) lowered value of land.

(b) Were these proceedings conducted through a lawyer or by personal application to the company?

(c) Did you receive the compensation sought?

2. Has any company ever offered, voluntarily, to compensate you for damage to your health or property?

If so, (a) What company?

(b) What type of damage?

(c) Did you accept the compensation?

3. Are you at present contributing to the collective lawsuit?

If so, what type of personal damage compensation are you applying for?

4. How many different lawyers have been handling the collective lawsuit?

5. Please specify the types of problems which have caused the dismissal of lawyers handling your case.

6. How much money do you estimate you have contributed to the legal costs?

7. How long have you been contributing money to the case?
8. Do you consider that your returns will justify the amount you have spent if the case is concluded in your favour?
9. How often have the companies offered to settle out of court?
10. What factors have prevented this type of settlement?
11. How many people belonging to the following professional groups are willing to present evidence on your behalf:
 - (a) medical practitioners
 - (b) soil scientists
 - (c) veterinarians
 - (d) gas/petroleum engineers
 - (e) chemists, biochemists
 - (f) wildlife officers
 - (g) district agriculturalists

F. POLLUTION MONITORING

1. Have you ever submitted any water samples for pollution testing to (a) Environmental Health Services?
 - (b) a private analyst?If so, briefly describe the types and levels of contaminants found.
2. Briefly describe any complaints you have about E.H.S. pollution surveys regarding:
 - (a) number of times air pollution monitoring in mobile laboratories is conducted.
 - (b) efficiency of equipment in mobile laboratories.
 - (c) efficiency of the continuous monitoring devices for air pollution.
 - (d) positioning of continuous and mobile devices.
 - (e) comprehensive monitoring of all possible air contaminants.
 - (f) number and accuracy of water pollution tests.

